DOCUMENT RESUME

ED 064 135 SE 013 873

AUTHOR	Pratt, Grace K.
TITLE	How to Care for Living Things in the Classroom.
INSTITUTION	National Science Teachers Association, Washington, D.C.
PUB DATE	65
NOTE	16p.
AVAILABLE FROM	NEA Publications Sales, 1201 16th Street, N.W., Washington, D.C. 20036 (Stock No. 471-14288 $0.35)
EDRS PRICE	MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	*Animal Facilities; *Biology; Elementary School Science; *Instructional Aids; *Science Facilities; Secondary School Science

ABSTRACT

In this National Science Teachers Association (NSTA) publication, the advantages of having living things in the classroom are discussed. Also given is a brief description of the facilities and environments required for various common mammals, fish, amphibians, reptiles, and plants. (CP)

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CARE FOR LIVING THINGS IN THE CLASSROOM

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WHY HAVE LIVING THINGS IN THE CLASSROOM?

What do living things add to a classroom? Although the squeal of a guinea pig or the thump of a rabbit may at times divert attention from more serious matters, the squealing or thumping creatures can be important to all members of the class.

A classroom equipped with plants and animals can become a laboratory for problem solving, reflective thinking and testing.[1] When inquiry, observation, and experiments are encouraged, the giving of "ready-made," "textbook" answers is kept to a minimum. Young children learn to connect cause and effect and find out why certain things happen. Plants and animals may stimulate speculation among older children and lead them to the use of scientific methods in conducting controlled experimentation. Through these processes they learn something of the tested limits of human control, such as how diet changes behavior and appearance or how the lack of light affects plants and animals. The differentiation between "self," and "others" is frequently clarified through the relationships of children and animals. Biological sameness and difference are exemplified. Familiarity with animals through daily contact overcomes gradually the fear which some children may have of them. Young children often feel secure when cuddling a classroom pet. Responsibility, kindness, and concern for life's requirements accompany the care of living things. While these concerns are peripheral to the development of understanding of scientific methods and to first-hand experiences with interrelationships in the natural world, they add to the many-faceted advantages of contact with plants and animals.

[1] *Grace K. Pratt, "Developing Concepts About Science in Young Children,"* Science and Children, *1: 21-22, December 1963.*

It is the purpose of this leaflet to give simple but adequate information to teachers who wish to have plants and animals in the classroom. No formal knowledge of biology is needed to be able to understand and use this information. City teachers frequently avoid keeping living things because they know little about them. Those who teach in smaller communities often assume that children know all about the living things around them and do not need to have plants and animals in the classroom. This leaflet attempts to treat the needs of the large-school and small-school teacher in either kind of community. Every plant and animal considered may be kept in a "pavement-bound" city school, and implications for greater breadth of activity are implied for the suburban and small community. Teaching methodology, as such, is not discussed in this leaflet. In addition, certain other items are omitted, such as, for example, the sex identification of mammals. Most teachers will obtain a male guinea pig or a pregnant rabbit and are unlikely to have more than one or two of these animals very long. Information, therefore, on how to "sex" mammals does not seem as necessary as some other items which are included. The Source List contains suggestions for teachers who desire information about topics not included in this pamphlet.

The animals and plants considered in this leaflet are chosen to meet the needs and interests of children from nursery school age to the upper elementary grades.

HOW TO INTRODUCE LIVING THINGS INTO THE CLASSROOM

When shall the teacher have living things in the classroom? The simplest answer is "always." Timing the introduction of plants and animals, however, is a very important factor.

During the first weeks of school, when the teacher is too busy getting children adjusted to

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1201 16th Street, N.W.
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be concerned with the care of animals, an empty cage will arouse the curiosity of children in the early grades. They will look forward to its possible occupant and to planning for its care.

Plans can be made to build cages or aquaria, to assemble needed materials for raising plants and animals and to obtain those which will live in the classroom. Books on plants and animals may be circulated among the children or displayed in the classroom and discussions on the habits and care of plants and animals initiated by the teacher.

Several hardy growing plants, such as coleus, begonia, or philodendron, placed about the classroom, may also create an interest in planning for later projects.

The brief checklist below (which is developed further for particular living things in later sections), will help the teacher prepare for plants and animals which will be brought into the classroom.

- A collection of clean aquaria, jars, pots, and boxes, of varying shapes and sizes, which can be converted quickly into temporary (or permanent) cages, containers, and planters
- Mesh wire and jar tops to be used as covers
- Heavy gloves for handling frightened animals or prickly plants
- A file of index cards on which are noted specific information and special experiences with particular plants and/or animals
- A few books dealing with common plants and animals (See Source List)
- A growing collection of audio-visual aids (See Source List)

Classroom location of living things is important, and the following items will have to be considered:

- Whenever possible, plants and animals should be placed in one location and left there.
- Drafts, sudden changes in temperature, sunlight, and proximity to radiators, ducts, and exits should all be considered.
- Plants must be placed on sturdy shelves or tables where they can be tended easily by the children.
- Plants and animals should be placed where they will not interfere with the space allotment or teaching of other subjects or be a distraction.
- Animals require a house or dark corner in their cages for rest. They should also be placed in a location which is readily supervised and safe from objects which might fall onto the cages.

Several other factors to be considered are summarized below:

- Selection of the proper animals (and their most advantageous use with each age or grade level), as well as safety of children, plants, and animals must be planned carefully.
- Provisions for food, water, sanitation, and other needs must be recognized as an integral part of having living things in the classroom.
- A few simple and necessary rules for the care and handling of animals and plants must be clearly understood and should be formulated by the teacher and children.
- Specific plans for daily care and the procedure for delegating responsibility should be clear to all.
- Holiday, weekend, and vacation care of animals and plants must be well planned in advance. (When animals and plants are kept in the children's homes during such periods, parents often understand more fully the important role played by living things in the lives of their children.)

WHICH LIVING THINGS SHALL WE CHOOSE?

ANIMALS

Among the many possibilities for the classroom, the following animals are suggested. They are easily cared for, representative of the many types of animals, and comparatively safe for children.

MAMMALS

Children are most familiar with the class of mammals; dogs and cats are of this class but mammals selected for the classroom are usually rabbits and members of the rodent order. Rodents include mice, rats, hamsters, and guinea pigs. These are interesting animals; they are clean and easily tended. While it is advisable to have female mice and rats, because of the occasional strong odor of adult males, either sex of hamsters, guinea pigs, and rabbits is equally acceptable.

Feeding

The children should feed the animals. The large feeding may be given in the morning after the children arrive and a smaller one before school is over for the day. Rabbits and rodents thrive on a mixture of hard grain or pellets and leafy vegetables, greens, lettuce, carrots, and apple cores. Hamsters hoard extra food in a corner of their cages and so should not be given excess food. All these animals drink water, and hamsters, mice, and rats will use a drip bottle (available in any pet shop) or may have a small dish or jar of water. Rabbits must have water available at all times, but no water is required for rodents if only one or two are kept in each cage and they are fed fresh lettuce twice daily. Salt is also important in their diet. If iodized salt is not contained in the pellets fed to them, some should be sprinkled twice a week over the lettuce or greens. Small salt blocks (available in rural feed stores) may be provided for rabbits. All these animals can be fed a double ration, on Friday afternoon, which will provide them adequately for the week end. Strange foods, or feeds they have not had recently, should be fed sparingly, or diarrhea is likely to result. The charts on food and water requirements summarize the amounts and types of foods to be given to the various animals.

Housing

Housing for rabbits and rodents varies from animal to animal according to their sizes and particular habits.

Rabbits

Since they have a tendency to burrow, rabbits should not be kept in a simple enclosure on the ground. They should be kept in a rabbit hutch, or cage, approximately 4 x 6 feet long and constructed of half-inch mesh wire nailed tightly around four 2 x 2-inch or 3 x 3-inch wooden uprights. These are connected by a frame of sturdy wood. If the hutch is on high legs, no top is needed, but a top is absolutely essential if there is a possibility that things might be dropped into the cage accidentally or if the hutch is ever moved out of doors, where protection from dogs and other predators must be considered. One end of the hutch should be enclosed with solid material and boarded off, leaving an entrance hole for the rabbit, so that he may rest away from the children. Half-inch mesh wire on the bottom, an

Photograph by Carl Purcell

inch or more above a movable tray, permits waste matter to fall through and facilitates cleaning. Shavings, straw, or Kitty Litter (a commercial product used for kitty toilets) provide a soft absorbent covering in the tray or in the bottom of a zinc-lined cage. Since rabbits use one or two corners of their hutch for elimination, these corners can be washed with hot water daily. A little pine oil disinfectant used in the water, or dropped into the cage keeps everything free from odor. While rabbits exercise freely in a 4 x 6-foot hutch, a smaller one, commercial or otherwise, may be used if the rabbit is permitted to hop about the room every day or two.

Guinea pigs

Guinea pigs are the most suitable rodents for the classroom. They are small enough to thrive in compact quarters and large enough to permit ease of handling by the youngest child in the school. Guinea pigs can live in a 2 x 4-foot cage, similar to, but smaller than, the rabbit hutch, which can be kept clean in the same way. Guinea pigs dirty the whole cage, but Kitty Litter is absorbent enough to last several days without cleaning.

Hamsters, mice, and rats

Hamsters, mice, and rats are nocturnal animals, but life in a classroom and frequent handling by the children accustoms them to being awake during the day. Hamsters, mice, and rats may be kept on Kitty Litter in a large wire-covered aquarium, or in regular cages bought for them. Since exercise is necessary to the animals' health, commercial cages are good because they contain exercise wheels. These wheels may also be bought separately and fitted into a home-made cage. Excellent exercise objects for mice and rats are small plastic ladders, usually made for parakeets, or rings, springs, and small strong plastic or metal objects fastened to the top of the cage and permitted to dangle.

Handling

Rabbits should be picked up by grasping the scruff of the neck with one hand and then quickly placing the other hand and arm under their feet for support. Under no circumstances should they be grasped by the ears. Rabbits thump their hind feet when frightened; they can claw and bite but will do so only when seriously threatened. While all breeds of rabbits make fine animals for the classroom, Dutch rabbits are recommended because of their smaller size. Space permitting, larger and heavier breeds, such as white Flemish giants, New Zealands, chinchillas, silver fox, or chequers (which may weigh up to 12 or more pounds) are very satisfactory. These large rabbits, however, are too heavy to lift by any but older children. A great deal can be learned from caring for angora rabbits. They need frequent brushing to keep their coats clean and unmatted and must also be plucked about three times a year. This is done by grasping a small amount of loose wool (which should be ready to come out anyway) between thumb and forefinger and pulling firmly. Combing, spinning, dyeing, and knitting the wool provide an occasional worthwhile project for older children.

Guinea pigs can be picked up in the same way as rabbits. However, their size and general desire to be held make it easy for children to "scoop" them up by thrusting one hand under them. Short-haired guinea pigs are the most common, but there are also long haired, or angora, guinea pigs. The latter are not usually plucked for their wool as are the angora rabbits. Colors may be black, brown, white, gray, yellow, or mixed.

It is best to pick up a mouse or rat by the tail, close to the body, and to place the other hand under it, immediately, for support. Even young children grow adept at this with a little practice. Unless the rat is very tame, however, heavy gloves should be used.

Hamsters may be grasped by the scruff of the neck, or by placing the hand right over them so that the head sticks out between thumb and forefinger. They may be held in both hands.

Reproduction

When one of these animals becomes pregnant, she should be placed in a cage by herself at least four or five days before the young are expected. The mother rabbit carries her young from 28 to 30 days. She prepares a nest of hay, if it is available, lines it with fur from the under part of her body, and covers the babies with fur after they are born. The mother rabbit should be left alone with her young, since she is likely to kill the newborn if she is disturbed. Rabbits are born blind and without fur, but in about ten days they are completely covered with soft fur and open their eyes. At this time they are very lively and may be watched without annoyance to the mother. Baby rabbits may be taken from the mother at six weeks. At this time, the sexes should be separated.

The gestation period of guinea pigs is about 63 days, and the young are born fully covered with hair and with their eyes open. There are usually three or four in a litter, and the time of weaning and of separation from the mother is similar to that for rabbits.

The gestation period of hamsters is about 16 days; of rats about 21 days; of mice from 20 to 22 days. Litters of these rodents range in number from 2 to 12 or 14, and average about 8. They are born blind and without fur and are kept covered in the nest made by the mother with bits of hay, cotton, or even cleansing tissues. These, or similar materials, should be given her in advance of the expected birth. Bits of meat may be fed to the expectant mother to help prevent her tendency to cannibalism.

Young hamsters, mice, and rats are nursed frequently. After their first week, the babies begin to nibble at bits of lettuce. They also like to eat some of the bread soaked in milk which may be given to the nursing mother. When the young are between 14 and 16 days old, their eyes begin to open, and the coat of fur, which has been growing steadily, covers their bodies. The mother will wean them at about four weeks.

The hamsters' true color does not appear until they are fully mature. Hamsters may be golden brown, albino, cream or champagne, or harlequins

Photograph by Carl Purcell

Oh, no! Don't hold them *that way!*

of mixed color. Mice vary from white to black through various shades and two color combinations of tan, brown, gray, and yellow. Rats are usually white or hooded with brown, cream, or black.

Male and female rodents should be separated by the time they are five weeks old. It is usually wise to give male mice and rats to a pet shop[2] at this time. If one is kept, keep him alone and pet him frequently. He is then less likely to be odorous.

FISH

Many specimens of fish may be selected for use in the classroom. Goldfish, however, are by far the most satisfactory. Of the tropical varieties, guppies are the hardiest and thrive best under school conditions. Children eight years old, or older, may be given responsibility for their care under the supervision of the teacher.

General requirements

Several factors are essential for successful raising of all types of fish. A rectangular aquarium with straight sides is more desirable than a round bowl since a maximum of air surface must be provided. It should have a loose cover to keep out dust, prevent the fish from jumping out, and to protect them from sudden temperature changes.

Water for use in an aquarium should be "conditioned" before use. This is especially necessary in the city where chlorine and other purifiers are frequently used. "Conditioning" is done by drawing and keeping the water in a clean receptacle for 24 hours before use. Commercial conditioners may be used if preferred.

A light is necessary; a pump and filter with glass wool and charcoal are recommended; and small white gravel, white pearl chips, or coarse white sterilized sand should be used as a bottom covering approximately one inch thick. The aquarium needs several green oxygen-producing plants such as sagittaria or vallisneria, and some anacharis or cabomba. These should be weighted down with a small mound of gravel so that they will root in the bottom. These plants grow wild in streams and lakes in many localities and are also available in pet shops. Wash them carefully in clear cool water before planting them in the aquarium.

Snails may be placed in the tank. Regardless of whether they are caught locally, or are bought in a pet shop, they should be kept in a separate water container for three or four days before being put into an aquarium to be certain that they are healthy.

[2] *The term petshop is used to denote a separate shop, or the pet and pet supplies department of any large store.*

If the aquarium is in the sun, colored cellophane can be put over the side facing the light. This will help prevent the growth of algae which appear like a green scum in the water.

Soap is poisonous to fish and should never come into contact with the water, aquarium, or anything which might go into it. Shells, small rocks, or ornaments should be rinsed thoroughly and examined for colorfastness, as dyes are also harmful. Only one or two shells should be used in the aquarium because the lime from the shells is not beneficial to fish.

Feeding

Fish should consume all of their food within five minutes or so after it is given to them. If some food remains, smaller amounts should be given in subsequent feedings. Children should be supervised in this respect as they may overfeed the fish. Tubifex worms, available in any pet shop, may be fed at least three times a week. The tubifex need to be rinsed with clear, cool water daily, and can be kept in a partially covered container in the bottom of a refrigerator. Two or three kinds of dried fish food can also be used for variety and a pinch of one kind may be fed each day.

Goldfish

Goldfish require a minimum of a gallon of water per inch of fish. Overcrowding and overfeeding are the most common reasons for their premature death. Although goldfish can survive being frozen into a cake of ice, radical temperature changes are not recommended. Water about 65 degrees Fahrenheit is preferable. Although light is necessary, several cabomba plants will give shade for rest during the day. The mother goldfish lays from 10 to 20 eggs at a time and usually lays a total of several hundred in the course of a season. The eggs hatch during a period of three to seven days. It is very unlikely, however, that baby goldfish will hatch indoors. The young, which may be brought in from an out-of-door pond, are dark at first and gradually grow brighter.

Varieties of goldfish include the common goldfish, the pop-eyed Telescope, the double-tailed Fantail, the large finned and long tailed Comet, the even longer tailed Fringetail, and the mottled Shubunkin.

Guppies

The life span of guppies is approximately three years. They thrive best when a heater keeps the water temperature between 70 and 80 degrees Fahrenheit. A small aquarium thermometer is useful. Since guppies bear their young alive, they are the most satisfactory tropical fish for the classroom. Several strains of guppies may be introduced gradually, and older children find it

fascinating to observe the different types of offspring. Up to 50 young may be born to each female every four to six weeks. They are rolled up when ejected from the mother, but unroll immediately and must swim to cover so that they won't be eaten by the adult fish. Cabomba plants placed in the aquarium can provide the young fish with a good hide-out. Feeding an extra ration of food to the adults when the young are born is also an excellent precaution to take. Very fine dry food (bought commercially) should be fed to the babies. If it is unavailable, grind the adult food into a powder with the back of a spoon.

Other selections for the aquarium

Any one of the several small varieties of tropical catfish is a useful scavenger in the guppy aquarium. Although almost constantly busy finding food which has fallen into the gravel, the catfish thrives if a few tubifex worms are dropped occasionally in front of him.

Small fresh water snails, such as pond snails, red ramshorn, Japanese, or Australian red, help to keep the aquarium clean, but their number must be carefully restricted. Most of these lay eggs that appear as tiny dots seen inside a jelly-like mass which is laid on a plant or on the side of the tank. They hatch and thrive under good aquarium conditions but become a nuisance when allowed to become too plentiful. Their activity may be observed through a magnifying glass.

Precautions

Purchase fish only from tanks in which all the fish look healthy. Watch for white fungus-like spots, torn tails and fins, or a scum-like substance on their bodies. Keep the fish isolated for at least three days before introducing them into the community tank. If you do get fish which show any such signs after purchase, add a pinch of iodized salt to the water. This may alleviate their condition. Five drops of 2 percent mercurochrome for each gallon of water may be left in the water for five or six days as a cure for "ich" *(Ichthyopthirius)*. If no remedy can be found for the disease ask the advice of the pet shop keeper.

AMPHIBIANS

Small amphibians such as green frogs and newts are easily kept. They grow best when only a small number, six to eight, are kept at one time, and the two kinds of amphibians should not be in the same aquarium.

As the name "amphibian" implies, these animals require an environment which provides land and water. Prepare their aquarium by placing an inch of gravel in the bottom. Place in it several rocks 2 to 6 inches high, cover them with moss and cover the bottom of the aquarium with about two inches of water. An alternative procedure is to cover the bottom with soil, or gravel, and to insert a dish of water to occupy approximately one quarter of the area of the aquarium. The top of the dish should be nearly level with the soil or gravel. Moist moss and bits of bark and leaves are then put over the soil to provide a damp shelter.

Newts

Newts, like all amphibians, hatch out from eggs to become larvae with external gills, which are in evidence for several months. While most eastern newts spend the second year of their lives on land, some newts never leave the water even as adults.

Eastern newts, in both the land and water stages, live well under aquarium conditions such as the one described above and are very easy to keep. During the water stages, eastern newts are brownish-olive in color, with red spots on their backs and black spots on their stomachs. During their land stage (usually the second year) they are known as "efts" and turn a bright red-orange color. They then return to water for the rest of their lives, resuming their original brownish-olive color. During their "water stage" they need more water and less land in the aquarium. Newts in land and water stages of development will live well together.

These bright-eyed, nimble, little amphibians are especially recommended for classroom use and study during either stage. Children can pick them up easily at the base of the tail and then support them on hand or fingers.

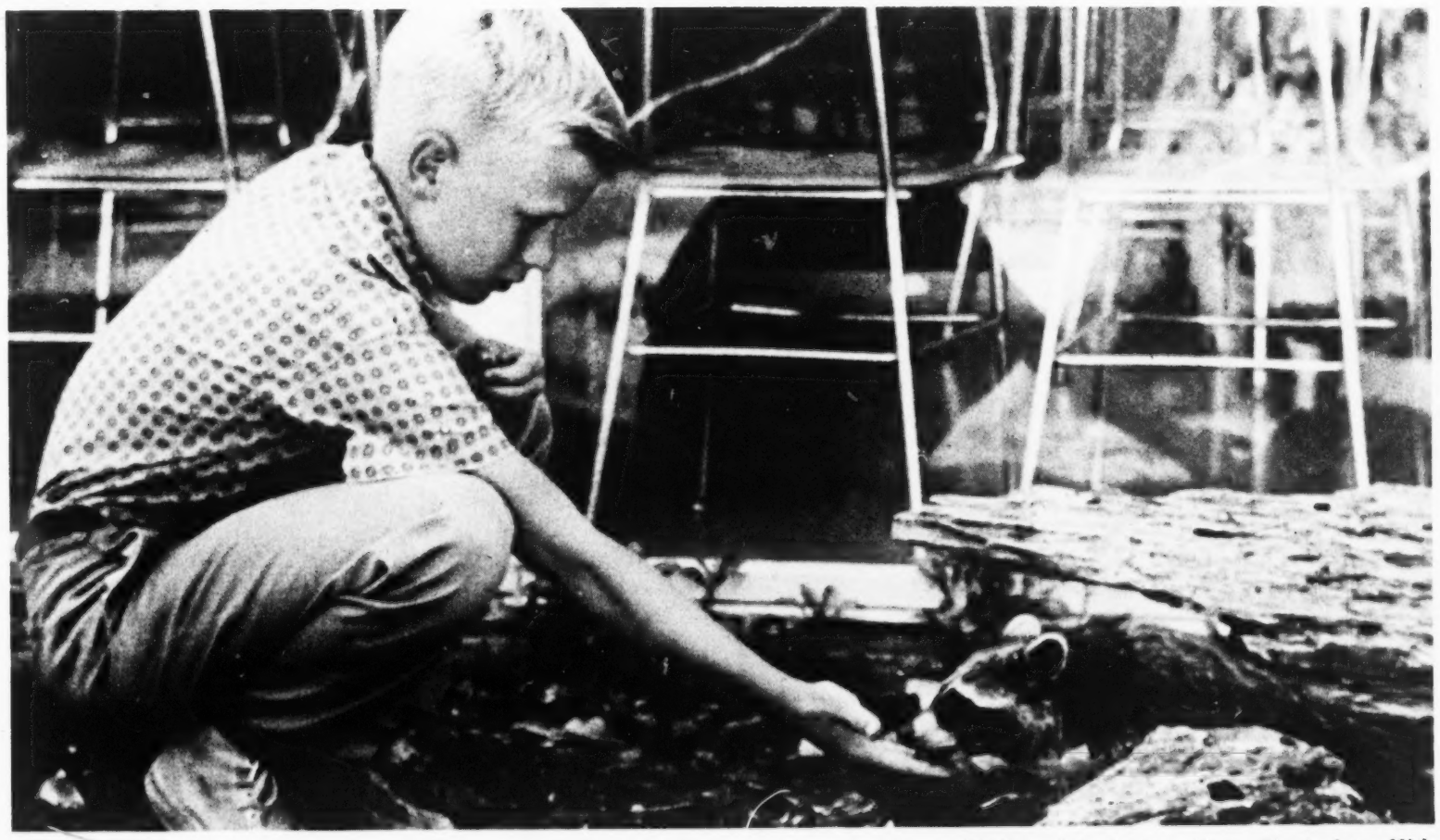
The larger western newt also lives well indoors in an aquarium affording land and water. The western newt appears to live near the water during his life span and in the water during the spring breeding period. Other smaller varieties such as the two-line salamander and the red-backed salamander, found under rocks in streams, are neither as hardy nor as satisfactory as the eastern or western newts.

Frogs

Of the various frogs, the small green frog is the easiest to keep. Males croak and females often make a slight squeaking sound. Males are readily distinguished by their larger ears which appear as round spots behind each eye. In males, the ear is larger than the eye; in females it is smaller. While they do not always adjust quite as easily to indoor life, pickerel frogs and leopard frogs may live for several years. Several kinds of frogs usually do *not* live well together.

Feeding

While frogs and newts relish earthworms, they do well on tubifex worms or meal worms, which are available in any pet shop. If a small amount of tubifex is placed a short way in front of him, on a toothpick for example, the frog or newt will grab it quickly. Since he likes live animals, he



Photograph by Barbara Marx, Birmingham, Mich.

A corner of the school yard, fenced in for keeping larger animals

may be tricked, when worms are not available, by being offered very small amounts of raw chopped beef placed on a toothpick and moved slowly in front of him. Feeding a small amount each day is best for classroom purposes, but slightly larger amounts three times a week are sufficient. Two small earthworms or meal worms or enough tubifex worms to cover three-quarters of the surface of a dime is a convenient way to measure an adequate daily ration. Both frogs and newts will occasionally pick at water plants.

Reproduction

Eggs, or spawn, are laid in masses by most female frogs. Each black spot, or egg, which is white underneath and surrounded by jelly, is a tightly rolled flat tadpole. Newt eggs are similar except that they are laid singly. In either case, place the eggs in an aquarium separate from that of the adults with water at the same temperature as that from which the eggs were taken. Leave the aquarium in the sun, and the tadpole or newt larvae will uncurl in a few days and emerge from the eggs. The length of time this takes depends on the temperature of the water. The young should not be overcrowded, and some, but not all, of the water in the aquarium should be changed daily. The "conditioned" water which is added should be of the same temperature as that already in the aquarium.

Within a short time, each larva will fill out to become a frog tadpole or a tiny newt larva with feathery gills. The legs of newts are visible within a short time but it takes longer before the legs of frogs appear. The hind legs of frogs may appear some weeks before the front ones. When the frogs-to-be have three or four legs and when the newts become a half inch long, add plants or sloping rocks to the aquarium to afford places for them to emerge wholly or partly from the water. This is necessary while they replace their gills with lungs.

Tadpoles will eat small droplets of raw egg yolk, infusoria, and other microscopic life as well as bits of lettuce.

REPTILES

Reptiles are cold-blooded animals which are classified into the following groups: turtles, lizards, snakes, alligators, and crocodiles. Turtles are convenient reptiles to keep in the classroom, snapping turtles being the only type definitely not recommended. Although the word tortoise is frequently used for those living on land, "turtle" is the most common overall term for the whole group.

The land turtle needs a habitat that consists primarily of land with a little water for drinking and occasional submersion. The water turtle requires mostly water with enough land to be able

to come completely out of the water and bask in the sun or under an electric light.

Feeding

Many kinds of turtles thrive on night crawlers, worms, raw chopped meat, and beef- or fish-flavored canned cat or dog food. Water turtles will eat little else except bits of water plants and lettuce. Land turtles will also eat berries, pieces of apple, tomato, peach, or melon, and lettuce, corn, peas, or beans. Young turtles of both types will eat tubifex and blood worms, ant eggs, and dried insects. Dried commercial turtle food should be fed occasionally but not too often: remember that water turtles must eat under water.

Kinds of turtles and their habits

In the wild state, turtles spend the cold winter months asleep in the mud or in the ground, but they will not usually hibernate when they are kept at room temperature and are given a small amount of food daily. A general rule of thumb for telling the sexes apart is that the male tends to have a concave plastron (or undershell), a longer tail and longer front feet claws than the female has. Turtles in captivity rarely lay eggs and almost all the ones sold in pet shops are "wild." When this does happen, however, the female digs a hole with her hind feet in the ground available to her, deposits the eggs, covers them, and ignores them.

The most common water turtles are the spotted turtle, the painted turtle (of several slightly different subspecies), and the mud turtle. An adult which is usually from four to six inches in length, will live well in a seven-and-a-half gallon aquarium. There should be several rocks in the aquarium to enable the turtle to climb completely out of the water.

Wood and box turtles are the most common land turtles. The Muhlenberg, though more water-loving than either wood or box turtle, can be classified with them. These turtles are protected in some states, and the local Fish and Game Laws, available from the town clerk or other local sources, should be consulted before they are captured. When obtained as adults, they do well in a tub or wooden box approximately 2 x 3 feet wide containing a layer of soil and a water container large enough for them to submerge completely. Food may be put in a small dish or presented to them from the end of a pointed stick.

Turtles will live for scores of years. Their most urgent need is seven to eight hours of sun or artificial light daily. Lack of light causes a state of lethargy in the turtle and may cause death. A little cod liver oil swabbed around its mouth with cotton or a toothpick, or mixed in its food will help overcome this lethargy, but providing needed light as a preventative is preferable.

Other possibilities

Although the animals noted above are the most adaptable to long stays in the classroom, there are others that make fine temporary visitors. Crickets, for example, in the fall of the year will live for a time in an aquarium containing some soil, and hay, or twigs. The females which lay eggs will usually die, but the soil should be kept, because baby crickets (nymphs) are likely to hatch from the eggs the following spring. (Eggs will sometimes hatch indoors in late winter.) The baby cricket splits his skin, discards it, and grows a larger one several times in the process of his development to adulthood. A few drops of water, some lettuce, corn, or bread are all the food that is needed. Only male crickets chirp. They do this by rubbing their wings and do not begin chirping until the wings are fully developed, which takes approximately ten weeks indoors.

Grasshoppers may be kept in a similar way. They enjoy eating grass as well as the foods mentioned above. Unfortunately temperature changes and the hot, dry atmosphere of the classroom usually prevent the long survival of either of these insects.

Commercial ant houses are the best means of ant keeping, but the small size of ants makes them better suited to children seven years of age and older.

The cocoons of various insects require some moisture. They can be kept in a wire or glass container with a wire top. A tiny water receptacle, kept full, helps prevent excessive dryness. Upright twigs will give the insect something to walk on or to attach to when it emerges from the cocoon.

Parakeets and canaries may be managed as visitors for a day, but their susceptibility to drafts makes an added burden for the teacher. Chickens, ducks, and pigeons are good temporary visitors also if there is space enough for a large cage, warmth for their young, and an adequate supply of food and water. Some teachers may wish to use a small two-egg incubator to allow the children to watch the whole hatching process of chickens or ducks.

REQUIREMENTS FOR VARIOUS ANIMALS

Food and Water Plants (for fish)	Rabbits	Guinea pigs	Hamsters	Mice	Rats
aily					
pellets	rabbit pellets: keep dish half full	large dog pellets: one or two			
or					
grain	keep dish half full	corn, wheat, or oats:	1½ tablespoon	canary seeds or oats: 2 teaspoons	3-4 teaspoons
green or leafy vegetables, lettuce, cabbage and celery tops	4-5 leaves	2 leaves	1 leaf	1/8–1/4 leaf	1/4 leaf
or					
grass, plantain, lambs' quarters, clover, alfalfa	2 handfuls	1 handful	1/2 handful	–	–
or					
hay, if water is also given					
carrots	2 medium	1 medium			
vice a week					
apple (medium)	1/2 apple	1/4 apple	1/8 apple	1/2 core and seeds	1 core
iodized salt (if not contained in pellets)	or salt block	sprinkle over lettuce or greens			
corn, canned or fresh, once or twice a week	1/2 ear	1/4 ear	1 tablespoon 1/3 ear	1/4 tablespoon or end of ear	1/2 tablespoon or end of ear
water	should always be available	necessary only if lettuce or greens are not provided			

	Goldfish	Guppies
iily		
dry commercial food	1 small pinch	1 very small pinch; medium size food for adults; fine size food for babies
vice a week		
shrimp – dry – or another kind of dry fish food	4 shrimp pellets, or 1 small pinch	dry shrimp food or other dry food: 1 very small pinch
vo or three times a week		
tubifex worms	enough to cover 1/2 area of a dime	enough to cover 1/8 area of a dime
ld enough "conditioned" water	allow one gallon per inch of fish	allow ¼–½ gallon per adult fish
keep tank at required level	add water of same temperature as that in tank – at least 65°F	add water of same temperature as that in tank – 70–80°F
ants		
cabomba, anacharis, etc.	should always be available	

	Newts	Frogs
iily		
small earthworms or mealworms	1–2 worms	2–3 worms
or		
tubifex worms	enough to cover 1/2 area of a dime	enough to cover 3/4 area of a dime
or		
raw chopped beef	enough to cover a dime	enough to cover a dime
water	should always be available at same temperature as that in tank or room temperature	

	Water turtles	Land turtles	Small turtles
ily			
worms or night crawlers	1 or 2	1 or 2	1/4 inch of tiny earthworm
or			
tubifex or blood worms			enough to cover 1/2 area of a dime
and/or			
raw chopped beef or meat and fish-flavored dog or cat food	1/2 teaspoon	1/2 teaspoon	
fruit and vegetables fresh		1/4 leaf lettuce or 6–10 berries or 1–2 slices peach, apple, tomato, melon or 1 tablespoon corn, peas, beans	
dry ant eggs, insects, or other commercial turtle food			1 small pinch
water	always available at room temperature; should be ample for swimming and submersion		
	3/4 of container	large enough for shell	half to 3/4 of container

Photograph by Carl Purcell

Plants may stimulate speculation and develop a sense of aesthetics in children

PLANTS

Hardy plants

What is a hardy plant? In this case—one able to withstand classroom living. Plants requiring substantial amounts of water are preferable for children of three, four, and five years of age because they enjoy caring for plants daily. Coleus, begonia, geranium, tradescantia, impatiens, and spider plant are quite dependable even in the hands of younger children because they will survive less delicate care. Older children enjoy caring for these as well as for additional more delicate plants. Plants growing in the classroom must be able to withstand some changes in temperature, especially during week-ends. The amount of available light, too, is an important consideration. Such plants as philodendron, pothos, nephthytis, snake plant, ivy, and Chinese evergreen are wise choices for a room with little or limited sun. Cactus and crown of thorns grow well in a sunny room, but care must be taken to teach the children not to overwater them. With full sun and a moist atmosphere, sensitive plants *(Mimosa pudica)* do well. Miniature roses thrive in a cool atmosphere whereas dwarf and scented geraniums flourish in full sun.

Why do plants grow spindly or die? The chief causes of failure in growing plants are lack of water or overwatering, or accidental placement too close to a hot radiator or a cold window. Plants should be fed small amounts of liquid or powdered fertilizer every two weeks. They also need to be observed periodically for indications of disease or insect pests and should be moved away from other plants when this is detected. A magnifying glass may be used for daily "pest inspection" by children eight years old and older. A gentle, weekly washing in lukewarm water is a good general preventative for disease and insects, and the practice keeps the leaf pores free from dust. Plant sprays and powders are readily obtainable for all pests, but should be used only by the teacher.

Which seeds to plant?

The short attention span of young children requires that the results of planting show within a few days. It is, therefore, important to choose seeds which come up quickly. For all ages, and especially for young children, the following are recommended seeds for planting in small individual flower pots, milk containers converted into planters, window boxes, flats from florists, or wooden cheese boxes: marigolds (especially dwarf French varieties), alyssum, cornflowers, nasturtiums, calendulas, zinnias (especially low varieties), morning glories (soaked for two hours before planting), radishes, bush beans, and raw Spanish peanuts.

Young children can manage milk container planters easily. Holes may be punched in the bottom with a table fork. Each container, of whatever sort, should have a drainage hole which is covered over with a shard (or fragment of earthen pot), and an inch or so of gravel, or shards. It should then be filled with rich friable (or easily workable) soil. Older children may wish to experiment with growing plants in vermiculite (a commercial product composed of small pieces of mica) and with using chemical solutions. Seeds should be planted one at a time. Children like to make holes for the seeds with their fingers, but care must be taken to see that they do not plant the seeds too deeply. They can press alyssum seeds lightly into the soil and sift a little soil over them; plant peanuts and beans two inches below the surface; and plant the other seeds about half an inch under the surface of the soil. The seeds should then be covered and pressed down gently but firmly with a hand or a block of wood. The containers should then be sprinkled with enough water to wet the soil thoroughly. All of the above-named seeds should germinate quickly and will show sprouts within a few days. Containers must be turned frequently to insure even growth.

Cuttings and divisions

Cuttings usually require at least a week or ten days to grow roots of sufficient length for planting. Children eight, nine, and ten years old have a long enough attention span to sustain interest in the whole process. Coleus, begonia, tradescantia, ivy, crown of thorns, and philodendron grow roots quickly. Coleus and begonia stems should be cut with a sharp knife two or three inches below the major leaves and below a node. The little ridges, or nodes, around the stem are the places from which the roots grow. Ends four or five inches in length may be broken from impatiens, tradescantia, and crown of thorns. Ivy and philodendron may be cut off at almost any place that insures a healthy growing end, but the cutting should not be more than six or eight inches long. The children can submerge the stems, almost to the leaves, in a vase or other container with water at room temperature. Light, but not bright sun, is advisable for the first four or five days, and then full sun is recommended for coleus, begonia, impatiens, tradescantia, and crown of thorns, and moderate light for ivy and philodendron. Stem cuttings of geranium and cactus may also be made and are usually allowed to dry for a day or two before being put in soil.

Spider plants may be divided. The baby plant is suspended on a long stem from the parent plant and grows roots while still attached. After the roots of the baby plant are at least half an inch long, the stem connecting it with its parent may be broken off. The young plant is then potted in good garden soil and usually grows rapidly.

African violets

With careful initial guidance, children nine years old or older can grow these plants successfully. To start new African violet plants, select a healthy looking leaf from near the bottom of a mature plant. With a sharp knife cut it off close to the point where the leaf stem joins the plant stem. After wetting the entire leaf gently, place the stem in water for about twenty minutes. Remove it from the water and lay it for about half an hour on a paper towel to dry it and to permit the cut end of the stem to "heal." Then place the stem in damp vermiculite almost all the way up to the base of the leaf. Be sure to keep the vermiculite well moistened. If the air tends to be dry, a plastic bag with a slit for air can be placed over the entire pot and leaf to keep it moist. After a period of three to six weeks, new plants will appear at the base of the leaf stem. When they are about two inches tall, remove the whole cluster of plants and the original leaf from the vermiculite, separate the tiny plants carefully and pot them in African violet soil. African violet soil is a sterilized mixture of equal parts of loam, peat moss, and vermiculite. It may be purchased in cellophane bags in a variety of stores. African violets like warm moist air, water at room temperature, and six to eight hours of direct light daily (either sun, electric, or fluorescent).

Bulbs

Bulbs are fun to grow in a classroom. Among the many bulbs available, the most satisfactory are the paper-white narcissus. Purchase large firm bulbs for winter planting from a florist, or other reputable source. Children can plant the bulbs in bowls of pebbles being certain that the bulbs neither touch each other nor the sides of the bowl. Stand the bulbs upright with smallest end facing upwards so that the pebbles come two-thirds of the way up the sides of each bulb. Keep the pebbles wet. Two or three small pieces of

Fascinating activities are suggested by the presence of growing plants in the classroom

charcoal under the pebbles will help keep the water pure. Put the bowl in a dark place for about ten days or until the tops are about an inch high and the roots have begun to grow. Then move the bowl out into the light. Approximately eight weeks from the time the bulbs were planted the flowers should be in bloom.

In a crowded classroom, hyacinth bulbs grown in hyacinth glasses or in water glasses with plastic collars (available from garden supply stores) are worthwhile. With more space, try crocus, grape hyacinth, and scilla which require about eight weeks to root and four more to bloom. They may be grown in damp sphagnum moss (which may be collected by the children in a damp meadow or woodland, or purchased). They should be planted about three inches deep in flower pots. Hyacinth bulbs, jonquils, daffodils, tulips, and amaryllis will also grow in soil and should be planted eight to ten inches deep.

Tubers and pips

The fragrance of lilies of the valley delights most children. Lilies of the valley may be grown in sphagnum moss indoors in winter and very early spring. Place the pips (individual root stocks) about an inch below the surface with the tips visible. Keep the moss damp, and in about two weeks, when the plants seem well rooted, move the planter into moderate light. The flowers should appear three or four weeks from the time the pips are planted.

Young children like to watch the "eyes" of potatoes sprout and grow. White potatoes or sweet potatoes may be grown indoors in pots of dirt, in window boxes, or in jars of water. Choose a white potato with prominent "eyes" or a sweet potato with observable green sprouts. When planting potatoes in window boxes or pots, place the part of the potato with the most "eyes" or strongest sprouts upward and cover the entire potato with an inch of soil.

Sweet potatoes grow especially well in jars of water. If a wide-mouthed jar is used, place the root end[3] of the potato down into the water, and insert three or four toothpicks around the potato about two-thirds of the way up its sides. The toothpicks resting on the lip of the jar suspend the potato in the water. This procedure permits air to circulate between the potato and the sides of the jar and prevents the potato from rotting. Two or three small pieces of charcoal in the water will keep it pure. Keep the water level of the jar nearly up to the toothpicks and place the jar in the sunlight. The sweet potato should soon grow a luxuriant, leafy top.

[3] *The root end is usually heavier and is opposite the end from which the potato was broken from the rest of the root.*

Making a terrarium

Children can make, or help make, a terrarium. Place gravel one inch deep in the bottom of an aquarium or flat-bottom jar and put several small pieces of charcoal in the gravel to adsorb impurities. Place several inches of rich soil over the gravel and moisten it well. Among the small woodland plants which grow readily in a terrarium are wintergreen, tiny ferns, cinquefoil, peppermint, and moss. An acorn or two may be placed in a high sided terrarium. To retain the moisture, cover the top with glass or plastic and set the terrarium where light, not necessarily sunlight, will reach it. Small toads or newts in the land stage, live well in a terrarium that includes a small dish "pond."

Other possibilities

Although the plants and techniques listed above are most successful for a classroom, other plants and techniques can also be used.

Mystery leaves *(Bryophyllum pinnatum)* may be picked from the parent plant, pinned on a curtain in either sun or shade, and small plants will appear in a short while in each scallop of the leaves. The new plants may be removed and potted in moderately rich soil when they reach a height of three-quarters of an inch. Five or six mystery leaves will usually be sufficient to provide each child in the class with his own plant.

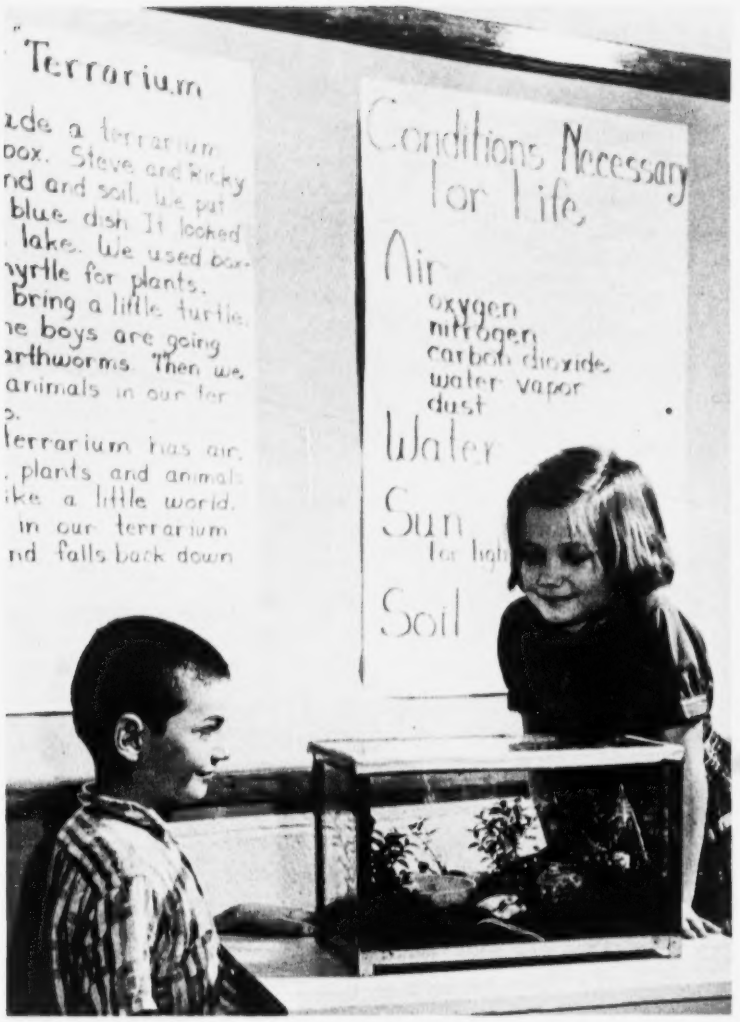
Children often notice tiny roots growing out of the branches of Christmas, crab, or Easter cactus. The ends of the branches may be broken off under the place where the roots show. Planted in moderately sandy but rich soil, these slips will usually grow well but are not likely to bloom for a long time.

Early in the fall before the winter heat is turned on, children can help transplant pansy plants, dwarf marigolds, English daisies, and compact petunia plants into pots and care for them in the classroom. The plants should be inspected carefully every day for evidence of insects. Given plenty of room and light, these plants thrive well indoors.

Avocado and citrus fruit seeds may also be grown. Since these are rather slow growing, they are more interesting to older children.

Section of Ti plants, or redwood burls placed in dishes and nearly covered with water are very attractive. Older children like to make them into scenes with tiny toy animals placed among the green shoots.

Young children also enjoy watching the growth of beet and carrot tops. Cut off the top inch of the vegetables as evenly as possible and place the top in half an inch of water in a saucer. It will soon grow a new top. The crown of a pineapple



A terrarium, filled with small plants and mosses, is a world in miniature

cut off so that a thin layer of fruit remains, grows well, too, when planted in a pot and exposed to partial sunlight.

The youngest child can sprinkle grass and canary seed on a damp and porous clay, cement, or old brick surface. This can be kept on a tray and the seeds grow rapidly if the surface is kept moist. Such surfaces may be purchased in a variety of shapes and assembled to form interesting arrangements.

Bush beans sprout rapidly in damp vermiculite. When planted in a glass jar, root growth is observable especially if a few of the beans rest against the sides of the jar. If some of the beans are planted in a jar of vermiculite at the same time that some are planted in a pot of soil, the two can be observed and compared, as the beans growing in the vermiculite can be lifted out easily, after they have begun to sprout. After two or three weeks, those in vermiculite can be thrown out because they usually become spindly unless they are given proper liquid nourishment. The beans planted in the soil can be kept for blossoms, and, hopefully, beans. Bush beans are recommended because of their compact growth.

Layering (a method of forming roots by bending a stem so that it comes in contact with the soil) is most successful with coleus, but can also be done with philodendron, ivy, jade plant, and tradescantia. Select a fairly long stem and bend it over so that it touches the soil, either in the plant's own pot, or in a separate pot. If necessary, fasten the stem to the soil with a hairpin or small piece of bent wire. Cover the pot or pots containing the plant and the part of the stem where layering is to take place with a plastic bag and make a slit or hole in the plastic bag to allow for air. Tiny hairlike roots will soon begin to show where the stem meets the soil. After they have grown about an inch and a half long, remove the plastic bag, cut off the stem from the parent plant about one-half inch under the new roots and transplant in rich soil. If the stem was layered in a separate pot, no transplanting is needed.

Air-layering can also be done. As the name implies, this is done without soil. Select a node on a coleus, philodendron, or jade plant, cover it loosely with plastic and wait for the new roots to form. When they are about an inch long, remove the plastic, cut off the stem below the young roots and plant in rich soil.

WHERE SHALL WE OBTAIN LIVING THINGS?

Collecting trips

Such trips are a successful source of supply for children from the time they are in kindergarten. Children, armed with plastic boxes, jars, bags, and some nets, can collect a variety of interesting living specimens from a small creek, field, or wooded area. Sweeping a net across a creek bottom or under a log in woods or field may yield a worthwhile collection. The contents can be shaken out of the net onto a piece of cotton flannel or woolen material. (The collection shows up best on colors other than white, brown, or black and remains best where shaken when the material is of such non-slippery cloth as flannel or wool.)

The teacher, of course, must have a thorough knowledge of the places to be visited. Permission to visit these places should be obtained well in advance, whenever necessary. A few clear, simple regulations can and should be formulated with the class before beginning any trip. With children through age seven, the area to be visited for collecting should not require walking further than about a quarter of a mile. The selection of specimens should be done in ways which will not deplete the available supply. The importance of conservation should always be stressed, especially with older children.

Sources of supply

Well-established, clean, preferably licensed pet shops, biological supply houses, pet supplies departments of large stores, and florists are most

likely to have quality products. If a class visit to the pet shop is contemplated, it should be visited first by the teacher. A friendly owner willing to have a class visit is a decided asset to any program. Such a pet shop owner is usually ready to plan the best time for all concerned. School or college laboratories are occasional sources of supply. There are a number of possibilities for loans such as loans from other classes, college laboratories, pet shops, hobbyists, and other interested persons in the community. Young children should obtain the expected animal or plant as soon as possible. But children nine years old or older may order what they plan to raise as they will not lose interest or grow impatient as readily while awaiting the arrival of the order.

Donations

Animals and plants donated by parents and children are usually given and received with the best of intentions. Such gifts, however, must be examined with a critical eye. A goldfish with a tiny white spot of "ich" for example, can contaminate a whole aquarium. Donations, however, are often a valuable source of supply and, when preliminary precautions are taken, may save much time, effort, and money.

Above all else, healthy stock must be selected. Plants with aphids or animals with nasal discharge have no place in the classroom. If the teacher neither knows how to judge a healthy plant nor how to look for pests and their eggs, he should deal only with a reliable firm and, if possible, seek the advice of an expert about the prospective purchase. Pet shops are usually a better source of supply for small rodents than are laboratories. Rodents raised in laboratories are not raised for pets and usually are not accustomed to being handled.

Plants and animals are an endless source of pleasure and knowledge. They provide many valuable learning experiences for teacher and children alike. These learning experiences may include observation, experimentation, problem solving, and use of scientific methods as well as speculation and finding out the present limits of human control. With forethought and planning, caring for living things in the classroom becomes an enjoyable part of daily learning experience.

Photograph by Barbara Marx, Birmingham, Mich.

Books

Axelrod, Herbert R. and Whitern, Wilfred. *Guppies.* T.F.H. Publications, Inc. Jersey City, New Jersey. 1957.

Axelrod, Herbert R. *Salamanders and Newts.* T.F.H. Publications, Inc. Jersey City, New Jersey. 1958.

Buck, Margaret W. *In Ponds and Streams.* Abingdon Press, New York, New York. 1955.

Cochran, Doris. *Amphibians of the World.* Doubleday and Company, Inc. New York, New York. 1961.

Free, Montague. *All About House Plants.* Doubleday and Company, Inc., New York, New York. 1951.

Gordon, Myron. *Guppies as Pets.* T.F.H. Publications, Jersey City, New Jersey. 1955.

Hausman, Leon. *Beginner's Guide to Fresh Water Life.* G. P. Putnam Co., New York, New York. 1950.

Kinney, Richard. *Guide to Gardening with Young People.* Prentice-Hall, New York, New York. 1955.

Morris, Percy. *Boys' Book of Turtles and Lizards.* Ronald Press, New York, New York. 1957.

Pet Hamsters. All-Pets Books, Inc., Fond du Lac, Wisconsin. 1958.

Teale, Edwin. *Insect Friends.* Dodd, Mead and Company, New York, New York. 1955.

Wailes, James R. *Living Things.* Vol. 1 of *Investigating Science with Children* series. National Science Teachers Association. 1964. Catalog No. 479-14266.

Zim, Herbert S., and Smith, Hobart M. *Reptiles and Amphibians.* A Golden Nature Guide: Simon and Schuster, New York, New York. 1953.

Magazines

The Conservationist, New York State Conservation Department, Albany, New York

Nature and Science, American Museum of Natural History, New York, New York

Nature Magazine, American Natural History Association, Washington, D.C.

Science and Children, National Science Teachers Association, Washington, D.C.

Films and Filmstrips

Coronet Films, Coronet Building, Chicago, Illinois
Films for the Primary Grades (1-3): Science
Films for the Intermediate Grades (4-6): Science

Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois
Films: Basic Life Science Program: Lower Elementary Living Things: Grades K-3; Grades 4-6
Filmstrips: Grade K-3, Grades 4-6

Eye Gate House, Inc., 146-01 Archer Avenue, Jamaica, New York
Science and Nature Filmstrips; For kindergarten, primary, and intermediate grades

Indiana University, Audio-Visual Center, Division of University Extension, Bloomington, Indiana
Listings by subjects for preschool, primary, and intermediate age levels

McGraw-Hill Publishing Company, Text Film Division, New York, New York
Young America Elementary Science Film Series
Elementary Science Filmstrips: Primary grades and middle grades

Supplies and Materials

Aquarium Stock Company, 31 Warren Street, New York, New York

American Society for the Prevention of Cruelty to Animals, 30 East 60 Street, New York, New York

General Biological Supply House, 8200 South Hoyne Avenue, Chicago 20, Illinois

New York Scientific Supply Co., Inc., 331 East 38 Street, New York 1, New York

National Association of Audubon Societies, 1130 Fifth Avenue, New York 28, New York

Trefflich Bird and Animal Co., 228 Fulton Street, New York, New York

Ward's Natural Science Establishment, Inc., 3000 Ridge Road East, P.O. Box 1712, Rochester, New York

Local sources:

aquaria; florists; green houses; laboratories of universities; museums; pet shops; pet supplies departments of large stores; wild animal farms; zoos.

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